REMARKS

The amendment to claim 1 is supported in applicant's specification at page 7, paragraphs 0082, 0083, 0084 of the corresponding published version of the patent application, Pub. No. US 2005/0092236. No new matter is added.

The amendment to claim 2 is supported in the specification at paragraphs 0082-0084. No new matter is added.

The amendment to claim 11 is supported in the specification at page 7, paragraphs 0082-0084. No new matter is added.

The amendment to claim 14 is supported in the specification at page 8, paragraph 0089. No new matter is added.

The amendment to claim 27 is supported in the specification at paragraphs 0020, 0049, 0052. No new matter is added.

The amendment to claim 30 is supported in the specification at paragraphs 0020, 0049, 0052. No new matter is added.

The amendment to claim 32 is supported in the specification at paragraphs 0020, 0049, 0052. No new matter is added.

The amendment to claim 33 is supported in the specification at page 8, paragraphs 0083, 0084. No new matter is added.

Election /Restrictions

Applicant's claims listing, submitted June 20, 2008 reflects applicant's election of group I, claims 1-11, 14, 18, 19, 20 and 27-33 drawn to an apparatus CZ system. Claims 12-13, 15-17, 21-26, and 34 were properly identified as withdrawn from consideration at that time. Applicant cancels the foregoing non-elected claims at the request of the Examiner, without prejudice to resubmit such claims in a divisional patent application.

Examiner's Invocation of 35 USC Sec. 112, Para. 6

Applicant acknowledges the application of examining guidelines for means plus function clauses pursuant to the case of In re Donaldson, 29 USPQ2d 1845 (Fed. Cir.1994).

Recitation of Intended Use

Applicant acknowledges the rule that expressions relating an apparatus to its contents during an intended operation are without patentable significance. In re Otto, 312 F. 2d 937, 136 USPQ 458, 459 (CCPA 1963).

However, apparatus claims may be recited functionally, MPEP 2114. (Emphasis added.) An aspect of applicant's invention solves the problem of how to produce low defect, single crystal silicon in a continuous CZ grower with high throughput and low cost. Applicant's structural features necessarily include a functional aspect to prove operability of the invention.

Furthermore, the entire apparatus of a CZ grower is directed to growing and pulling a defect free crystal or ingot from a crystal / melt interface. The growing crystal affects the thermal balance of the entire system. An aspect of applicant's invention uses the growing crystal as an integral part of the thermal environment of a CZ system. Individually controllable heaters provided at a fixed distance adjacent the crucible achieve local control of heat flux through the melt and crystal, resulting in a controlled flow of heat and an associated temperature profile through the melt.

Accordingly, applicant respectfully submits that operations, such as apparatus for affecting the crystal melt interface and thermal conditions in or across the crucible, are inherent in the description of a CZ grower apparatus. The future product is the silicon wafer made from the pulled crystal.

Double Patenting

Claims 1-11, 14, 18-20, and 27-33 are subject to a provisional obviousness – type double patenting rejection. Applicant respectfully requests that a terminal disclaimer pursuant to 37 CFR 1.321, curing such rejection, be filed upon the Examiner's indication of allowable subject matter.

Claim Rejections under 35 USC sec 102 (b); Altekruger, US Patent No. 5,360,480

Claims 1, 4, 6 and 7 stand rejected under 35 USC 102 (b) as anticipated by Altekruger, US Patent No. 5,360,480. For a rejection under section 102 to stand, each and every element of applicant's claim must be shown in the reference.

Altekruger '480 recites in relevant part that heating elements 33 and 34 "together form an opening in the center of the bottom heater through which the crucible stem 26 reaches...to the melting crucible 14 and by which the melting crucible 14 can be moved up and down." Col 3, lines 6-12. (Emphasis added.) Accordingly, Altekruger '480 discloses only a single bottom heater

10 provided with a center opening through which the crucible is moved up and down as well as rotated relative to the heater. Col 3, lines 6-12. Thus, the heater of Altekruger '480 is not "provided adjacent the crucible" and cannot establish a thermal distribution across the crucible as set forth in applicant's claim 1 as amended.

In contrast, applicant's claim 1 as amended recites in relevant part that applicant's annular heating elements are "separately controllable... each heating element for transferring a desired amount of thermal energy to an adjacent portion of the crucible" for providing an optimal thermal distribution across the crucible.

In as much as the crucible of Altekruger '480 is moved vertically and rotated with respect to the bottom heater, such a heater is not "provided adjacent the crucible" and cannot possibly be controllable for transferring a desired amount thermal energy to adjacent portions of the crucible for establishing a thermal distribution across the crucible as set forth in claim 1.

Altekruger further teaches mounting the crucible on a stem, by which the crucible can be raised and lowered. Col. 3, lines 1-3. In contrast, applicant's claim 1 recites that the melt / crystal interface is maintained without vertical travel of the crucible. Thus, the rejection of claim 1 as anticipated by Altekruger '480 is respectfully traversed.

In as much as Altekruger '480 neither teaches nor even suggests the desirability of adjacent base heater elements for establishing a controllable thermal distribution, and fails to suggest the desirability of maintaining a crystal / melt interface without vertical travel of the crucible, applicant's invention as set forth in claim 1 as amended is also not obvious in view of Altekruger '380.

Claims 4, 6 and 7 depend from claim 1 and incorporate the foregoing limitations by reason of such dependency. Thus, claims 4, 6 and 7 are believed to patentably distinguish over Altekruger '380 for at least the same reasons as claim 1. Reconsideration and allowance of claims 1, 4, 6 and 7 are respectfully requested.

Rejection of Claim 14 under 35 USC Sec. 102(b) as Anticipated by Altekruger, US Patent No. 5,492,078

Claim 14 stands rejected under 35 USC Sec. 102(b) as anticipated by Altekruger, US Patent No. 5,492,078 The '078 reference discloses a control system, wherein dopant particles are put into single file along the route to the melting crucible. The single file area has at least one sensor to count the particles, and the output of each sensor is connected to a first input of a counter, which has a second input for a reference input element. Column 3, lines 25-28.

For a rejection under 35 USC Sec. 102 to stand, each and every element of the claimed invention must be shown in the reference. The '078 patent is directed to dopant. In contrast, applicant's claim 14 recites feedstock. The '078 patent fails to disclose or even to suggest applicant's load cell mechanically coupled with the crucible for sensing the weight of melt in the crucible for dispensing crystalline feedstock as set forth in claim 14 as amended. The '078 reference can have no mechanical coupling of a load cell due to the need for vertical travel of the crucible. See Figure 1.

Neither is claim 14 as amended obvious in view of the '078 reference. The '078 reference uses sensors to generate a count pulse and to determine the size of dopant to separate particles into single file for introduction to a "melting crucible." See column 3, lines 8-13 and col. 2, lines 55-60. In contrast, applicant's invention is not directed to single file input of dopant to a crucible, but rather advantageously accelerates throughput of solid feedstock to a pre melter, where the feedstock is melted and then provided to the crucible based on sensed weight of the crucible as set forth in claim 14. Thus, applicant's invention provides the advantages of allowing crystal growth to be run with a much lower charge of melt than in a conventional CZ process. The invention also advantageously contributes to reduced dwell time of the silicon in the crucible and provides reduction in impurities and further enables a new crystal to be started more quickly after emptying the crucible. See applicant's specification, paragraphs 0064-0065.

Accordingly, claim 14 as amended is believed to patentably distinguish over the '078 reference. Reconsideration and allowance of claim 14 are respectfully requested.

Rejection of Claims 2-3, 11, 27-31 and 33 Under 35 USC Sec. 103, Altekruger '480 In View of Azad, US Patent No. 5,162,072

Claims 2-3, 11, 27-31 and 33 stand rejected under 35 USC Sec. 103, under Altekruger '480 in view of Azad, US Patent No. 5,162,072, for the proposition that it would have been obvious to combine the CZ system of Altekruger with the controller system for individual heaters set forth in Azad '072. The rejection of Claims 2-3, 11, 27-31 and 33 is respectfully traversed for the following reasons.

By reason of dependency on claim 1, applicant's claims 2 and 3 incorporate the limitation that the heater elements are disposed adjacent the base of the crucible that holds the melt without vertical travel. Claim 11 as amended recites a fixed crucible that holds the melt without vertical travel. Claims 27, 30, 32 and 33 as amended also recite a fixed crucible that holds the melt without vertical travel. Claim 31 includes such limitation by reason of dependency on claim 30.

In contrast to the forgoing claims, Altekruger '480 teaches a base heater provided with a center opening through which a crucible "stem" extends so that the melting crucible can be moved up and down as well as rotated. Col 3, lines 6-13. Azad '072 teaches a heater platform mounted on a lifting means. Col 6, line 61-63. Azad '072 likewise teaches at col. 4, lines 1- 8 that the crucible is capable of being raised and lowered in the frame by a vertical lift and rotation mechanism. Further, Azad states that in the preferred embodiment, "the crucible 12 and lifting means 46 for the heater platform 40 may be coupled to the same vertical lift mechanism 101." See col. 7, lines 10-12, emphasis added.

Thus, there is no motivation or even a suggestion in either Altekruger '480 or Azad as to the desirability of providing a fixed crucible without vertical travel as set forth in applicant's claims 2-3, 11, 27-31 and 33. Even assuming that the references could be combined, such a combination would not disclose applicant's heaters disposed adjacent the base of the fixed crucible as set forth in claims 2-3, 11, 27-31 and 33.

When, as here, there is no suggestion to combine the teachings of the references, except from using applicant's invention as a template for hindsight reconstruction, the rejection for obviousness should be withdrawn. Ex Parte Crawford et al, Appeal 20062429, Decided May 30, 2007. Reconsideration and allowance of claims 2-3, 11, 27-31 and 33 are therefore respectfully requested.

Rejection of Claim 5 Under 35 USC Sec. 103; Altekruger '480 In View of Lorenzini, US Patent No. 4,454,096

Claim 5 stands rejected under 35 USC Sec. 103 for the proposition that it would be obvious to incorporate the teachings of Lorenzini '096 with those of Altekruger '480 to process silicon faster and more efficiently with multiple process chambers. The rejection for obviousness is respectfully traversed.

Applicant's claim 5 recites the distinction that a plurality of crystal pull chambers (in contrast to growth crucibles) sequentially position an ingot in a fixed growth crucible, pull the ingot and move the grown ingot out of the crucible. This provides the advantages of simplicity of structure processing speed and high throughput. Claim 5 also incorporates the feature of a fixed crucible without vertical travel by reason of dependency on claim 1.

In contrast to applicant's single crucible with multiple pull chambers, Lorenzini teaches a plurality of vertically moveable growth crucibles, each crucible having its own separate crucible lifting and crystal pulling mechanisms, and heater. Col. 3, lines 27-29.

Lorenzini and Altekruger also teach only vertically moveable crucibles. See Figures 1, 4, 6 and 7 of Lorenzini and col. 3, lines 27-29. There is no teaching or suggestion in either reference as to the commercial value and advantages of fixing the growth crucible and eliminating the need for vertical travel and allowing a plurality of pull chambers to communicate with the fixed crucible for higher processing speed and throughput.

The apparatus of Lorenzini is unduly complex, expensive to implement and would fail to achieve the processing speed of applicant's multiple pull chambers sequentially switched to a single crucible. In as much as there is no motivation, evidence, or suggestion in either reference, alone or in combination of applicant's sequentially positioned growth chambers with respect to a single crucible, applicant respectfully requests withdrawal of the obviousness rejection. (Ex Parte Katoh et al, Appeal 20071460, Decided May 29, 2007)

Rejection Of Claims 8-9 And 32 Under 35 USC Sec. 103; Altekruger '480 In View Of Azad '072 And Further In View Of Lorenzini, US Patent No. 4,454,096

The rejection of claims 8-9 and 32 for obviousness is respectfully traversed. An objective of applicant's invention is to achieve high throughput of substantially defect free single crystal silicon in a continuous Czochralski system by eliminating the need for vertical travel of the crucible and heaters, and providing a series of crystal pulling chambers for pulling crystals from a single growth crucible. As set forth in applicant's specification (US Pub. No. 20050092236) at paragraph 0065, this advantageously eliminates the complex mechanisms in a conventional CZ system necessary for coordinating vertical travel of the crucible with the pulling of the crystal, and enables heaters to be positioned on the base of the crucible. This greatly simplifies the apparatus needed for growing single crystal silicon and achieves accelerated production of single crystal silicon at lower cost.

Accordingly, claim 8 recites in relevant part the distinction of "multiple crystal pull chambers sequentially disposed with respect to the crucible, such that upon growth of a first ingot, a first pull chamber moves the first ingot out of the crucible for cooling, and a successive pull chamber moves to position a new crystal in the crucible." Claim 8 further recites that "melt in the crucible is maintained at a desired level with respect to the crystal, without vertical travel of the crucible." (Emphasis added.) Claim 9 includes the foregoing limitations by reason of dependency on claim 8. Claim 32 similarly recites in relevant part, "a fixed crucible..., such that the melt / crystal interface is maintained at a desired level without vertical travel of the crucible."

The reliance on Altekruger'480 in view of Azad '072 in view of Lorenzini '096 is respectfully traversed in that the references disclose only vertical lifting mechanisms for lifting a

crucible and heaters as set forth above. Lorenzini '096 discloses a plurality of vertically moveable growth crucibles, each with its own crucible lifting and crystal pulling mechanisms as well as its own separate furnace that is lifted with the growth crucible. See col. 3, lines 27-29 and Figures 1-6. Contrary to the assertion in Lorenzini '096 that the system would reduce capital costs, practical implementation of such a system would be so complex as to defy common sense.

Absolutely no suggestion exists in the combination of references as to how vertical travel of the crucible and heaters could be eliminated to render obvious applicant's claimed fixed crucible and plurality of pull chambers for sequentially pulling an ingot without vertical travel of the crucible.

Without such a suggestion, an obviousness rejection cannot be maintained. Ex Parte Crawford et al, Appeal 20062429, decided May 30, 2007.

Rejection Of Claim 10 Under 35 USC Sec 103; Altekruger '480 In View Of Azad '072 In View Of Lorenzini, '096 And Further In View Of Lim, US Pat. No. 5,314,667

Claim 10 stands rejected under 35 USC Sec 103; in view of Altekruger '480 in view of Azad '072 in view of Lorenzini,'096, and further in view of Lim, US Pat. No. 5,314,667. The examiner's proposition is that it would have been obvious to use the weir of Lim with the foregoing combinations to divide the molten zone of crystalline material in the crucible, allowing concentrated pools of crystalline material to form prior to pulling the crystal boule from the melt.

The rejection for obviousness in view of the foregoing combination is respectfully traversed. Applicant's claim 10 depends from claim 8 and incorporates by reason of dependency the limitation of multiple crystal pull chambers sequentially disposed with respect to the crucible such that upon growth of a first ingot, a first pull chamber moves the first ingot out of the crucible for cooling, and a successive pull chamber moves to position a new crystal in the crucible.

The combinations of Altekruger '480 in view of Azad '072 in view of Lorenzini,'096 are respectfully traversed for the reasons set forth in detail above.

Lim teaches a circular baffle placed within a growth crucible containing a molten bath of crystalline material, dividing the crucible into an annular feed zone and an inner crystal growth zone. The boule or ingot is withdrawn from the central crystal growth zone. Col.2, lines 43-47. In contrast to applicant's invention, Lim is a discrete as opposed to a continuous process as included in the scope of claim 8. Moreover, there is no suggestion or motivation to combine the baffle of Lim with the crucibles disclosed in Altekruger '480, Azad '072, and Lorenzini,'096 as set forth above.

Even assuming *arguendo,* that such a combination were possible, it would nevertheless fail

to disclose applicant's continuous process of multiple crystal pull chambers sequentially disposed with respect to the growth crucible incorporated in claim 10 by reason of dependency on claim 8. Accordingly, reconsideration and allowance of claim 8 are respectfully requested.

Rejection Of Claims 18 And 20 Under 35 USC 103a As Being Unpatentable Over Altekruger '480 In View Of Lim, '667

Claims 18 and 20 stand rejected under 35 USC 103 as being unpatentable over Altekruger '480 in view of Lim, '667, the examiner stating basically that it would be obvious to combine the apparatus of Altekruger '480 with the weir and ceramic material of Lim.

Lim '667 discloses a vertically moveable crucible, Figures 1-3, as does Altekruger as set forth above. Thus, there is no evidence or suggestion in Altekruger '480 or in Lim '667 of applicant's fixed crucible, such that the melt / crystal interface is maintained at a desired level without vertical travel of the crucible; and separately controllable heater elements for transferring a desired amount of thermal energy to an adjacent portion of the crucible as incorporated in applicant's claim 18, by reason of its dependency from claim 1. In as much as neither reference either expressly or implicitly suggests the foregoing limitations, alone or in combination, claim 18 is believed to patentably distinguish over Altekruger '480 and Lim. In re Bond, 910 F.2d 831,834; 15 USPQ2d 1566, 1568 (Fed. Cir. 1990).

Claim 20 is a multiple dependent claim, containing the limitations of claim 1 as set forth above and claim 7. Accordingly, claim 20 distinguishes over the combination cited for at least the same reasons as claim 1, above.

Reconsideration and allowance of claims 18 and 20 are therefore respectfully requested.

Rejection of claim 19 Under 35 USC 103a As Being Unpatentable Over Altekruger '480 In View Of JP 62176981

Claim 19 stands rejected under 35 USC 103a as being obvious over Altekruger '480 in view of Japan patent document JP 62176981, the examiner citing Altekruger '480 for a wide aspect ratio crucible having annular heating coils adjacent the base, and JP '981 teaching the use of silicon carbide or boron nitride coating of the crucible stating that it would have been obvious to incorporate the teachings of JP '981 with those of Altekruger.

The examiner's rejection of claim 19 on the foregoing basis is respectfully traversed. Claim 19 incorporates the limitations of claims 1 and 7 by reason of multiple dependency. Neither Altekruger '480 nor JP '981 individually or in combination teaches or even suggests applicant's structure set forth in claim 1, wherein the melt / crystal interface is maintained at a